



Chapter 4

Industry 5.0 From Automation to Autonomy: Engineering the Shift

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ABSTRACT

The advent of Industry 4.0 brought about a transformative wave of automation and digitalization in manufacturing and industrial processes. However, the next phase of industrial evolution, Industry 5.0, focuses on achieving a seamless integration of humans and machines, shifting the emphasis from automation to autonomy. This explores the key concepts, challenges, and opportunities associated with this paradigm shift. Industry 5.0 represents a paradigmatic transition that seeks to harness the power of advanced technologies such as artificial intelligence (AI), robotics, the internet of things (IoT), and cyber-physical systems (CPS) to empower human workers and enhance their capabilities. The goal is to create a collaborative and symbiotic environment where humans and machines work together to achieve higher levels of productivity, efficiency, and innovation. This chapter delves into the primary drivers behind the transition to Industry 5.0. One key factor is the increasing complexity and variability of manufacturing processes, which demand greater flexibility and adaptability.

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1. INTRODUCTION

1.1 Overview of Industry 5.0

Industry 5.0 focuses on achieving a seamless integration of humans and machines, shifting the emphasis from automation to autonomy (Breque et al., 2021). Industry 5.0 is an evolution that leverages the progress achieved in Industry 4.0 with the goal of fostering a manufacturing and production approach that is centered around human involvement (Longo, Padovano, & Umbrello, 2020). Industry 5.0 aims to combine human and machine skills to achieve increased productivity and wider societal benefits, while Industry 4.0 focused on the integration of automation, data sharing, and digital technology.

1.2 Important Aspects of Industry 5.0

- **Human-Machine Collaboration:** Industry 5.0 places a strong emphasis on human-machine cooperation, recognizing that each possesses unique strengths. While machines handle repetitive tasks and data processing, humans contribute their creativity, problem-solving skills, and emotional intelligence.
- **Augmented Workforce:** Industry 5.0 envisions a workforce augmented with advanced technology like virtual reality, augmented reality, robotics, and artificial intelligence. These technologies enhance human capabilities, enabling workforces to achieve complex jobs more securely and effectively.
- **Customization and Personalization:** Industry 5.0 has led to a greater emphasis on product customization. Advanced technologies enable mass customization, where products can be tailored to individual customer needs and preferences without compromising efficiency or cost-effectiveness.
- **Localized and Sustainable Production:** Industry 5.0 promotes localized production, enabling manufacturing to be closer to the end consumers. This reduces the need for extensive global supply chains and transportation, leading to lower carbon emissions and increased sustainability.
- **Ethical and Social Responsibility:** Industry 5.0 emphasizes the ethical and social responsibilities of organizations. It encourages companies to consider the well-being of workers, the community, and the environment. This includes fair wages, safe working conditions, and environmentally friendly practices.
- **Reskilling and Upskilling:** As Industry 5.0 introduces new technologies and shifts job requirements, there is a growing emphasis on reskilling and upskilling the workforce. Continuous learning and development programs

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